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FOUNDATION INVESTIGATION

PROPOSED LAKESIDE CONDOMINIUM, "MOANAWAI"
MOANALUA, OAHU, HAWAII

FOR

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LOYALTY ENTERPRISES LTD.

Dames Moore Job No. 3013-005-11

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May 4, 1973

Loyalty Enterprises Ltd.
233 Merchant Street
Honolulu, Hawaii 96813

Attention: Mr. Clarence Ching

Gentlemen:

Submitted herewith are four copies of our report entitled "Foundation Investigation, Proposed Lakeside Condominium, Moanalua, Oahu, Hawaii, For Loyalty Enterprises Ltd."

The scope of work was described in our proposal dated March 23, 1973. Our investigation essentially conformed to the proposed scope of work.

Preliminary design information was transmitted verbally to your structural engineer to facilitate his design.

Soil samples not used for laboratory testing and rock core samples will be retained for a six-month period for possible inspection by your contractor. Unless directed otherwise, they will be discarded six months following the date of this report.

It has been a pleasure participating on this project with you. Should you have any questions regarding our work or the contents of our report, please contact us for clarification.

Yours very truly,

DAMES & MOORE

W. E. Estes

WEE:WGS:my

cc: Milton Sher & Associates
Attention: Mr. Milton Sher

FOUNDATION INVESTIGATION
PROPOSED LAKESIDE CONDOMINIUM
MOANALUA, OAHU, HAWAII
FOR
LOYALTY ENTERPRISES LTD.

SUMMARY

The site is considered satisfactory for the proposed condominium building and related facilities. The structure can be founded in volcanic tuff rock or granular soil. For footings placed in the natural clinder materials, a bearing pressure of 6000 pounds per square foot may be used. For footings placed directly over tuff rock, at least four feet thick, a bearing pressure of 8000 pounds per square foot may be used.

The proposed development will not have significant effect on the tunnel which extends beneath the site, and conversely, the existence of the tunnel will not affect the proposed construction.

INTRODUCTION

This report contains the results of our foundation investigation for a proposed condominium building in Moanalua, Oahu, Hawaii. The proposed site is located in the Salt Lake area, the general location of which is illustrated by the Map of Area, Plate I. Specifically, the

building site is to be situated on the southwest corner of Likini Street and Ala Napunani Street (TMK 1-1-62:24, 25, 26, 27, and 28) as shown by the Plot Plan, Plate 2.

The scope of our work was to develop subsurface information which would be applicable to project design and construction. To accomplish this scope, two borings were drilled and samples of subsurface materials obtained for evaluation of their engineering properties. An analysis was made of work previously performed by others in the site area. Our work also included consideration of possible effects of the proposed construction upon a drainage tunnel situated beneath the site.

PROJECT CONSIDERATIONS

It is our understanding that the proposed condominium facilities will include a tower 16 stories in height, and a 2-level parking structure separated from the tower. A portion of the tower is to be located over an existing drainage tunnel easement. The structure will be supported by bearing walls which will impose loads of about 45 kips per linear foot of wall, except for the outside stair shaft wall, which will be designed for a wind load of 500 kips per linear foot. A swimming pool will be located along the northern edge of the site.

SITE CONDITIONS

SURFACE

The site is situated on the side of a north-west-facing interior slope of Salt Lake crater. Two benches have been constructed at the site; one, which is to contain the tower, slopes northwestward from elevation +61 feet to +50 feet, the other also slopes northwestward from elevation +49 feet to +36 feet and is to contain parking and recreation facilities. Portions of each bench are cut into rock, and the remainder consists of overlying sand and gravel or fill material which was removed from the cuts.

At present, the site is occupied by a one-story wood-frame office building. The adjoining lot immediately west of the site contains a four-story concrete structure.

SUBSURFACE

The site is situated on the rim of Salt Lake Crater, a secondary eruption in the later volcanic stages of Oahu's development. Volcanic ash and ejecta have been cemented in place to form hard volcanic tuff and tuff breccia rock. Generally, the tuff is massive, and is sometimes overlain by a few feet of gravel or sand fill and/or a dense brown silty gravelly sand. This rock was

penetrated by both of our borings, and may be seen in road cuts and trenches near the site. The tuff is of variable thickness, and in places overlies a fine to coarse dense cinder sand and clayey cinder sand. The sand, if present, overlies a silt complex consisting of light brown stiff to hard silty clay and sandy or clayey silt. Where the sand is not present, the tuff lies directly upon clay or silt. The base of the silt complex was not encountered by our borings.

A drainage tunnel has been constructed by tunneling through the silt complex. The tunnel passes beneath the northeast corner of the proposed structure at an approximate depth of 44 to 48 feet. It is our understanding that the tunnel is of arch roof design, lined with reinforced gunite, and is 11 feet in height and 10 feet in width. The tunnel was constructed to carry drainage from Salt Lake to a storm sewer near Puuloa Road.

To explore the subsurface conditions beneath the site, two borings were drilled at the locations shown on the Plot Plan. The borings were drilled by a subcontractor under our constant field inspection. Cores were obtained of rock encountered in the borings to evaluate the competency of the rock underlying the site. Soils were sampled with our Type U sampler, and the recovered materials returned to our laboratory for test-

ing. A detailed description of the field exploration, including boring logs and the results of laboratory testing, are contained within the Appendix attached to this report.

Ground water was not encountered in the borings. The actual ground water surface is near the tunnel floor at about sea level.

CONCLUSIONS AND RECOMMENDATIONS

TUNNEL STABILITY

A review of our files was made to gather existing information regarding the drainage tunnel beneath the site. This information was summarized in a preceding paragraph, SITE CONDITIONS, SUBSURFACE.

We are of the opinion that the proposed structure would have negligible effects on the tunnel; conversely, the presence of the tunnel would have negligible effects on the proposed construction.

FOUNDATIONS

The 16-story structure can be satisfactorily supported on spread footings placed in a competent rock or soil. We recommend the use of a bearing pressure of 8000 pounds per square foot for footings placed directly over tuff formation that is at least four feet thick. Other-

wise, footings placed on natural sand or gravelly sand should be designed to a bearing pressure of 6000 pounds per square foot. Thus, to ascertain the thickness of tuff under the wall footing, the bottom of the footing should be sounded by test pits or drilling to at least four feet deep. The bottom of all footings should be at least two feet below the lowest adjacent grade.

The same criteria should be used for footings for the garage structure.

Excavation in tuff rock should be thoroughly cleaned of loose debris or loosened rock pieces prior to placing of steel.

All foundation excavations should be inspected by a qualified soils engineer to verify that the exposed materials are capable of satisfactorily supporting the imposed loads.

SLABS-ON-GRADE

It is our opinion that building slabs and pool decking can be satisfactorily supported at grade. A minimum four-inch thick open graded gravel should be used beneath any concrete slabs in habitable areas. A vapor barrier or membrane should be placed under the slabs and the base course gradation should be sufficient to provide a capillary break.

Concrete pool decking can be constructed immediately over on-site materials or compacted granular fill. No base course should be required provided the ground surface is free of clayey or silty materials.

RETAINING WALL

It is our understanding that a basement wall will also be designed to retain earth fill below ground level. Generally, the wall should be designed for a lateral earth pressure of 65 pounds per square foot per foot of depth on the vertical face of the wall. It is imperative that there be no lateral deflection of the wall during the backfilling operation of the wall. Thus it appears that buttress type lateral supports would be preferable to provide adequate rigidity during construction. It is suggested that, in reviewing the proposed construction schedules by the contractor, the state of the wall during the backfilling should be carefully evaluated in regards to potential lateral deflection.

SITE GRADING

It is our understanding that some fill and possibly some additional cut operations will be required at the site. In general, on-site materials will be suitable for use in compacted fills provided that the material is

free of adobe, debris, and rock pieces in excess of six inches in their maximum dimension. The site should be stripped prior to any fill placement, and to remove all vegetation and scattered debris.

Fills should be constructed in six-inch maximum lifts and compacted to 95 percent of the respective maximum dry densities as determined in accordance with ASTM compaction test designation D-1557. Fill beneath pavements should be compacted to 95 percent compaction in the upper 12 inches of subgrade. The construction of fill should be inspected to ascertain that the materials and compacted densities are satisfactory.

EXCAVATIONS

Excavations will be required during foundation construction for the multi-story structure including the elevator shaft and for the swimming pool. Based on our prior experience in the Salt Lake volcanic tuff formation, excavation can be accomplished by tractor equipment with ripper attachment.

PAVEMENT DESIGN

Based on test results on compacted volcanic tuff fill within Salt Lake, the CBR value can be expected to range from 30 to 40 on samples compacted to 95 percent

- 9 -

percent of the maximum dry density. We believe that the site is suitable for a minimum pavement section composed of either 2 inches of asphaltic concrete over 4 inches of base course, or 3½ inches of full depth asphalt placed directly on properly compacted volcanic tuff fill. The base course should have a minimum CBR rating of 85.

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The following Plates and Appendix are attached
and complete this report:

Plate 1 - Map of Area

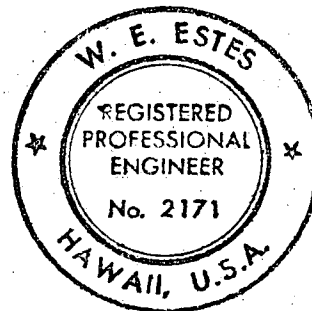
Plate 2 - Plot Plan

Appendix - Field Exploration and Laboratory Testing

Respectfully submitted,

DAMES & MOORE

W. E. Estes
W. E. Estes

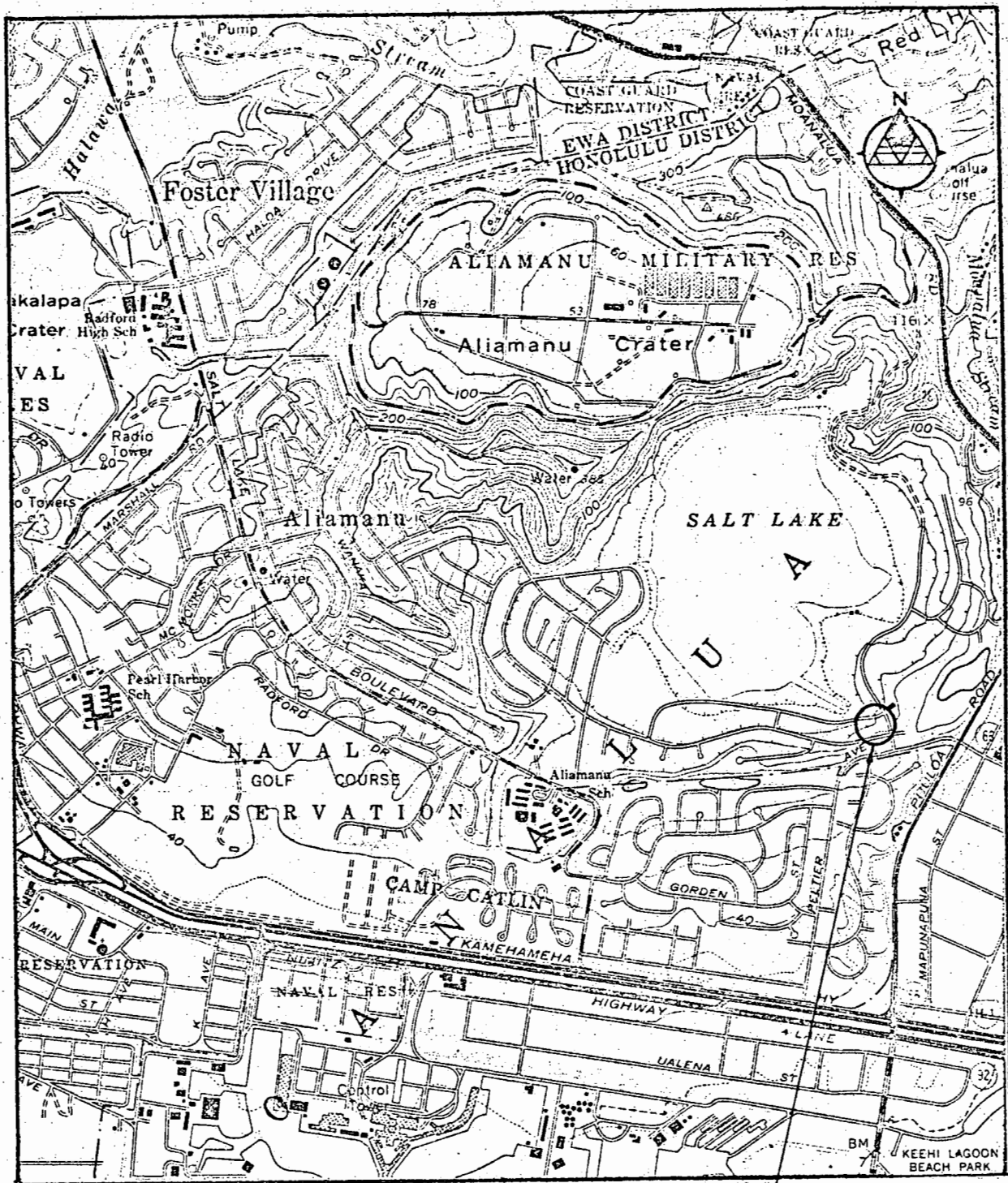


THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION

W. E. Estes

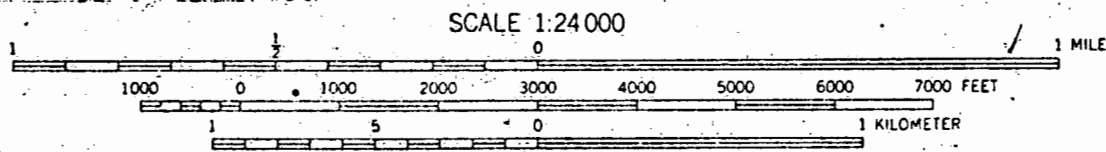
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REVISIONS BY DATE
 FILE 3013-005
 DATE 4-24-73
 CHECKED BY wlf



GENERAL LOCATION OF SITE AS SHOWN ON PLOT PLAN

MAP OF AREA

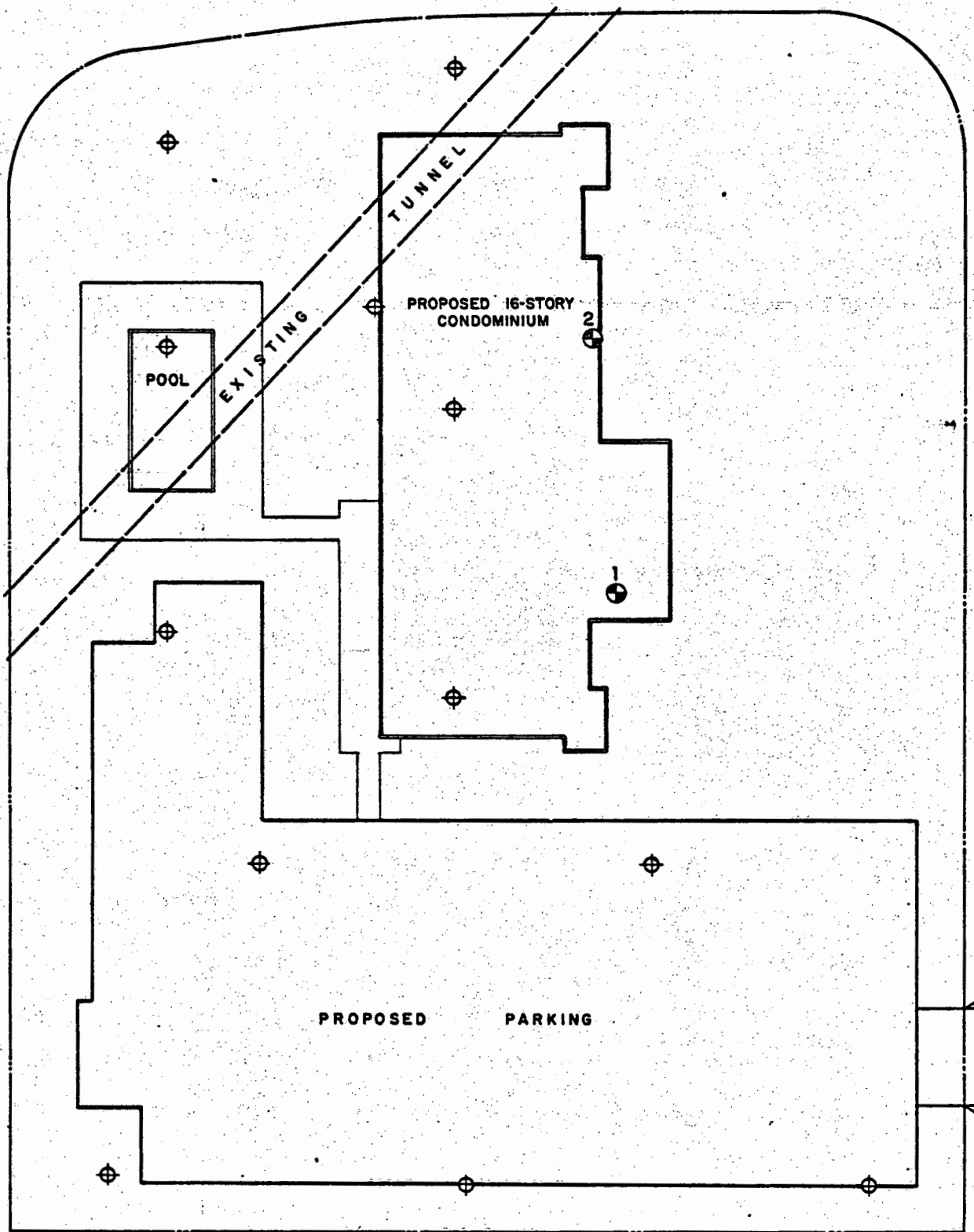


REFERENCE:
 U.S.G.S. QUADRANGLE MAP
 PUULOA, HAWAII
 DATED 1968



DAMES & MOORE

L I K I N I STREET

ALA ILIMA STREET

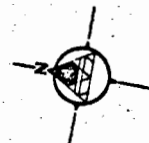


LEGEND

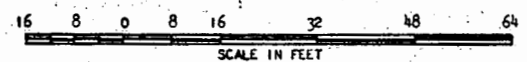
-  DAMES & MOORE BORING
-  BORING BY OTHERS

REFERENCE

FIRST FLOOR PLAN (RECREATION-UTILITY)
 LAKESIDE CONDOMINIUM
 PREPARED BY MILTON SHER - ARCHITECT & ASSOC.
 DATED 12-14-72



PLOT PLAN



DAMES & MOORE

APPENDIX

FIELD EXPLORATION AND LABORATORY TESTING

Field exploration was conducted at the project site during March 30 through April 2, 1973. This work was performed in two phases by one of our engineering geologists; a preliminary site reconnaissance and exploratory drilling.

The reconnaissance phase was completed on March 30, 1973. At that time, our engineering geologist examined the land features, soil conditions, and existing structures at and near the site. Exposures of volcanic tuff and the underlying silt complex were examined with respect to the proposed structure and drilling locations. Preferred drilling locations were checked for accessibility and possible damage to existing structures. The field reconnaissance phase revealed that the overlying tuff had an undulating nature and varied in thickness. Slight jointing at low angles were observed. The silt appeared very stiff to hard, and immediately followed the base of the tuff in the exposures observed. The reconnaissance facilitated the development of the drilling and sampling program which followed.

The exploratory drilling phase of our work was conducted on April 2, 1973. The Log of Borings are provided on Plates A-1A and A-1B of this Appendix.

The drilling was accomplished by a subcontractor using a Mobile Drill, Model B-61. This is a truck-mounted rotary drill with hydraulic wash that also has augering capabilities. Our engineering geologist located the boring positions, provided constant supervision during the drilling phase, selected the most efficient drilling and sampling techniques for the materials encountered, and obtained relatively undisturbed soil samples. NX type cores were obtained of rock materials encountered.

A series of two borings were drilled during the last phase of the field exploratory work. The borings were positioned to provide detailed information about the subsurface materials found at the site. The soils encountered in the borings were classified in accordance with the Unified Soil Classification System; a description of this system is included as Plate A-2.

Soil samples were obtained with a Dames & Moore Type U sampler. An illustration of this sampler is provided on Plate A-3. Selected samples were utilized for laboratory testing which included Atterberg limits,

- A3 -

triaxial compression, and moisture-density tests and determinations. Test data are presented on the Log of Borings.

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The following Plates are attached and complete this Appendix:

Plate A-1A - Log of Borings, Boring 1

Plate A-1B - Log of Borings, Boring 2

Plate A-2 - Unified Soil Classification System

Plate A-3 - Soil Sampler Type U

BORING 2

MOISTURE CONTENT IN %
 DRY DENSITY IN PCF
 BLOWS/FT. ON SAMPLER
 CORE AND % RECOVERY
 SAMPLES AND/OR CORES
 DEPTH IN FEET
 GRAPH SYMBOL
 LETTER SYMBOL
 SURFACE ELEVATION
 DESCRIPTION

29.0	94.9	100/ 4"			5	SM	BROWN SILTY GRAVELLY SAND FILL WITH OCCASIONAL COBBLES. BROWN SILTY GRAVELLY FINE TO MEDIUM SAND.	DENSE
						MH	BROWN SANDY CLAYEY SILT. BROWN TUFF ROCK.	VERY STIFF HARD
		100/ 2 1/2"			10			
27.8 32.5	95.0 90.7	75			15	CH	LIGHT BROWN SILTY CLAY. SOME FINE SAND CONTENT	VERY STIFF
		5 1/5"				ML	LIGHT BROWN FINE SANDY SILT.	HARD

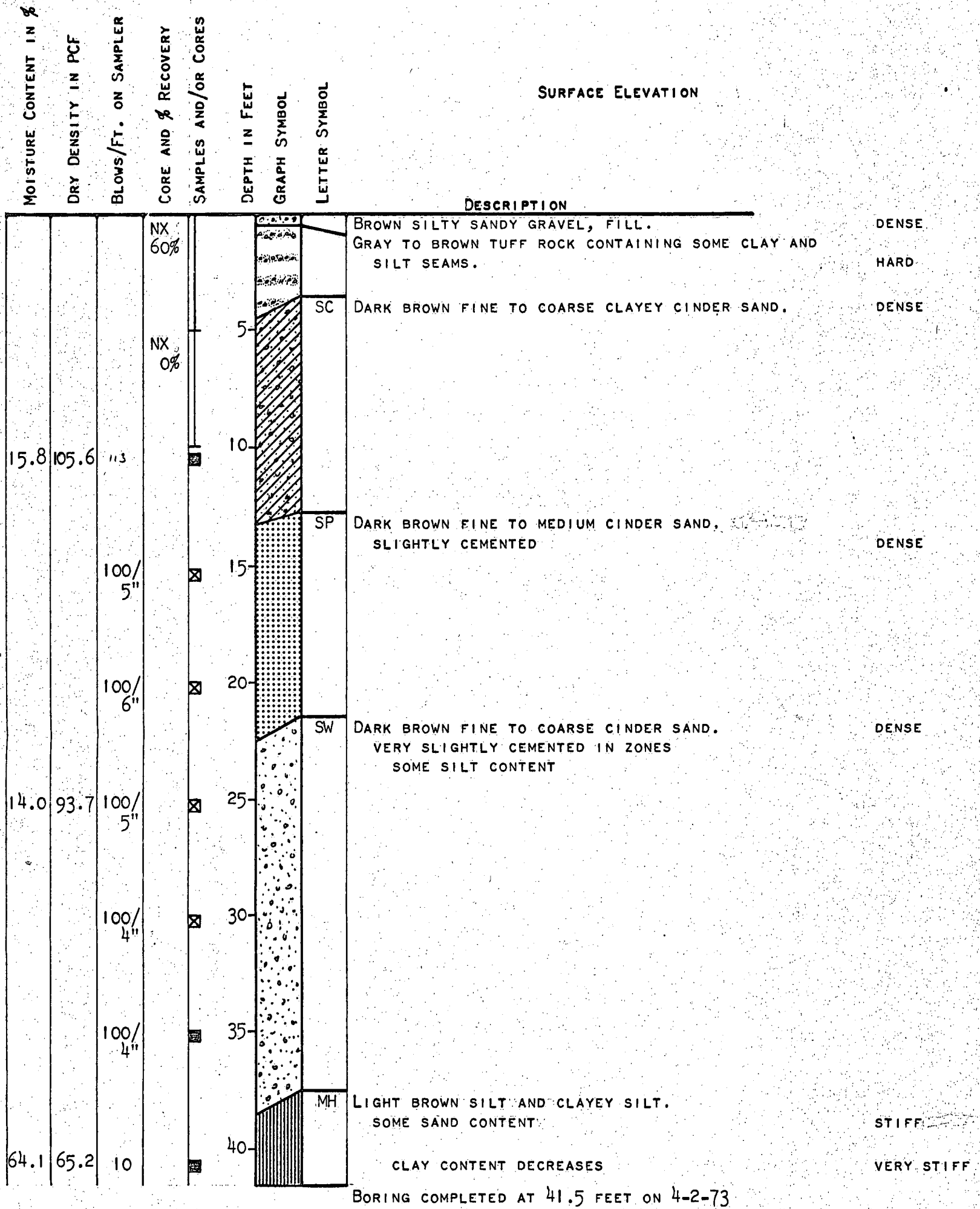
BORING COMPLETED AT 19.8 FEET ON 4-2-73

LOG OF BORINGS

NOTES:

- -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
 - ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
 - -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
 - I -DEPTH AND LENGTH OF CORE RUN
- DRIVING ENERGY - 300-LB WEIGHT DROPPING 30 INCHES

BORING 1



LOG OF BORINGS

NOTES:

- ☐ - DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
 - ⊗ - DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
 - - DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
 - I - DEPTH AND LENGTH OF CORE RUN
- DRIVING ENERGY- 300-LB WEIGHT DROPPING 30 INCHES

SOIL CLASSIFICATION CHART

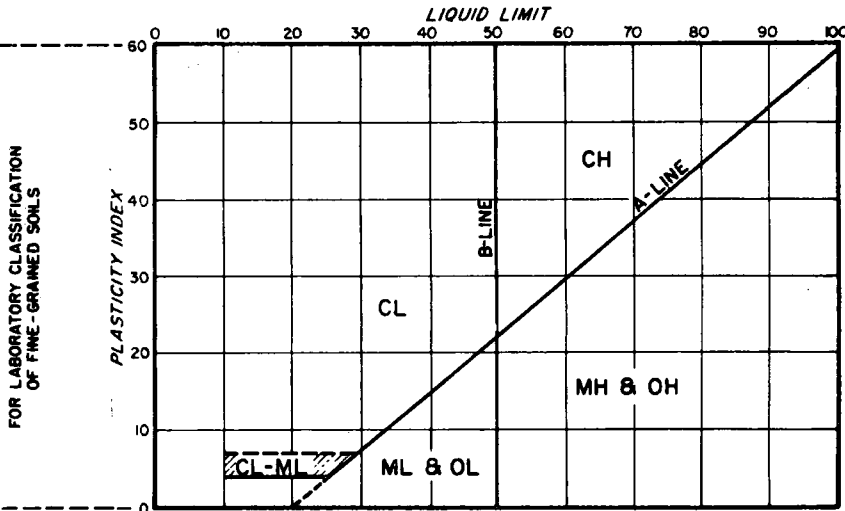
MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)			
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

GRADATION CHART

MATERIAL SIZE		PARTICLE SIZE			
		LOWER LIMIT		UPPER LIMIT	
		MILLIMETERS	SIEVE SIZE*	MILLIMETERS	SIEVE SIZE*
SAND					
	FINE	.074	#200*	0.42	#40*
	MEDIUM	0.42	#40*	2.00	#10 *
	COARSE	2.00	#10*	4.76	#4 *
GRAVEL					
	FINE	4.76	#4 *	191	3/4" *
	COARSE	191	3/4" *	76.2	3" *
COBBLES		76.2	3" *	304.8	12" *
BOULDERS		304.8	12 *	914.4	36"

* U.S. STANDARD * CLEAR SQUARE OPENINGS

PLASTICITY CHART



- NOTES:
- DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS.
 - WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF COHESIONLESS SOILS.

COHESIVE SOILS		COHESIONLESS SOILS	
	(APPROXIMATE SHEARING STRENGTH IN KSF)		
VERY SOFT	LESS THAN .25	VERY LOOSE	THESE ARE USUALLY BASED ON AN EXAMINATION OF SOIL SAMPLES, PENETRATION RESISTANCE, AND SOIL DENSITY DATA.
SOFT	0.25 TO 0.5	LOOSE	
MEDIUM STIFF	0.5 TO 1.0	MEDIUM DENSE	
STIFF	1.0 TO 2.0	DENSE	
VERY STIFF	2.0 TO 4.0	VERY DENSE	
HARD	GREATER THAN 4.0		

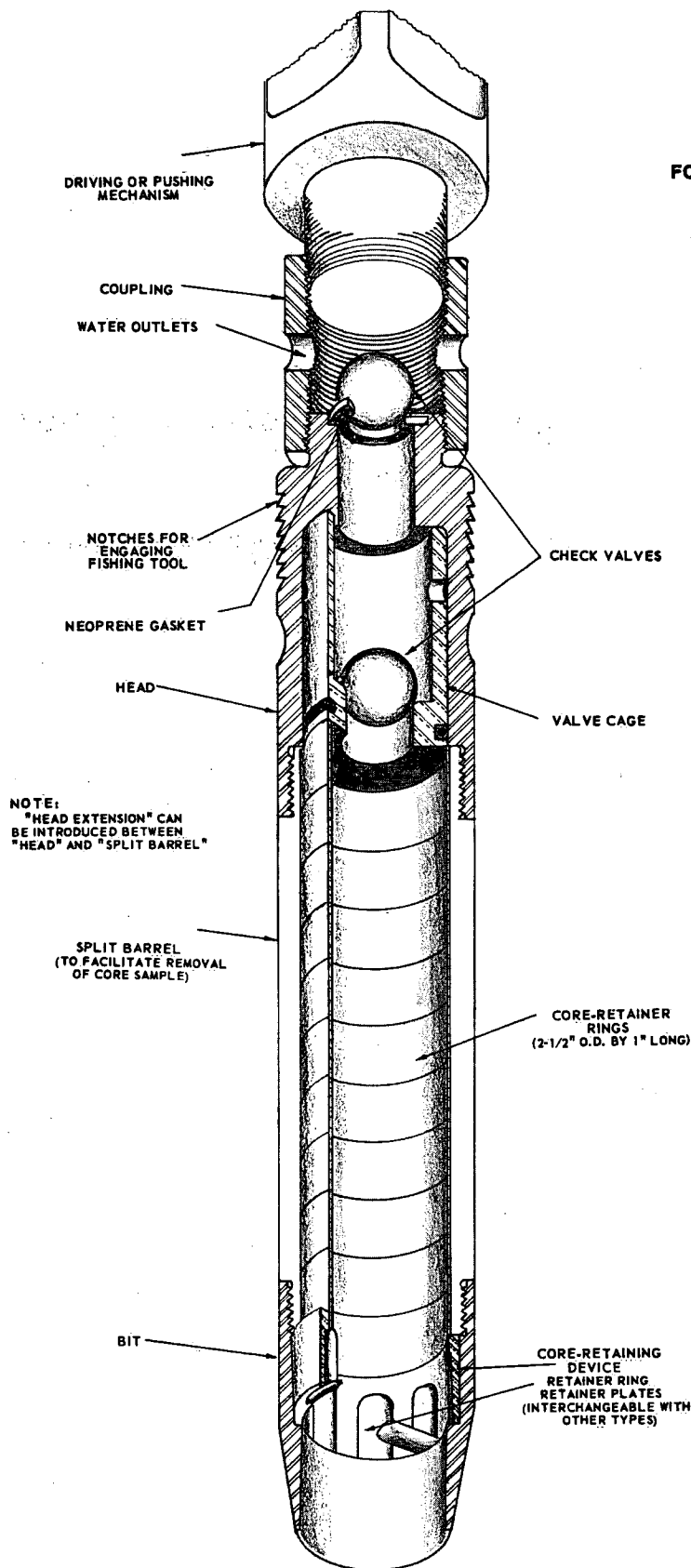
SAMPLES

- INDICATES UNDISTURBED SAMPLE
- INDICATES DISTURBED SAMPLE
- INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- INDICATES LENGTH OF CORING RUN

NOTE: DEFINITIONS OF ANY ADDITIONAL DATA REGARDING SAMPLES ARE ENTERED ON THE FIRST LOG ON WHICH THE DATA APPEAR.

UNIFIED SOIL CLASSIFICATION SYSTEM

SOIL SAMPLER TYPE U FOR SOILS DIFFICULT TO RETAIN IN SAMPLER



ALTERNATE ATTACHMENTS

